BICYCLE AIR PUMP

BACKGROUND OF THE INVENTION;

There are many types of air pumps presently available. However, hardly any bicycle owners carry an air pump on their bicycle. The two main reasons for this is because most bicycle owners don't like to cluster the outside appearance of their bicycle as well as worry that someone may steal their air pump.

SUMMARY OF THE INVENTION;

A major object of the present invention is to provide an air pump that can fit inside the frame of a bicycle;

Another object of the present invention is to provide an air pump which can be easily inserted and removed from the inside of the bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, regardless of the size and make of the saddle post and/or the bicycle frame, so that the air pump may fit into substantially all sizes and makes of bicycles being sold or already on the market;

Another object of the present invention is to provide an air pump which can easily be inserted and removed from the inside of the bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, regardless of the size and make of the bicycle frame, further comprising biasing means for generating a frictional force to prevent the bicycle pump from sliding down the saddle post into the bicycle frame, where it would be difficult to get out of;

Another object of the present invention is to provide an air pump which can be easily inserted and removed from the inside of the bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, regardless of the size and make of the bicycle frame, further comprising biasing means for generating a frictional force to prevent the bicycle pump from shaking or moving around while the bicycle is being ridden;

Another object of the present invention is to provide an air pump which

can easily be inserted and removed from the inside of the bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, regardless of the size and make of the bicycle frame, further comprising biasing means for generating a frictional force to prevent the bicycle pump from sliding down the saddle post into the bicycle frame, where it would be difficult to get out of, the biasing means comprising a flexible plastic or nylon pipe inserted into the frame portion;

Another object of the present invention is to provide an air pump which can easily be inserted and removed from the inside of the bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, regardless of the size and make of the bicycle frame, further comprising biasing means for generating a frictional force to prevent the bicycle pump from sliding down the saddle post into the bicycle frame, where it would be difficult to get out of, the biasing means comprising a plastic or metal spring inserted into the frame portion below the air pump for providing a constant force on the bottom end of the air pump, whereby, the air pump is not only prevented from sliding down the frame but also, due to the inherent characteristics of springs of being able to change their length, depending on the force applied, to automatically adjusts the height of the air pump to allow for changes in the height of the saddle position;

Another object of the present invention is to provide an air pump which can easily be inserted and removed from the inside of the bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, regardless of the size and make of the bicycle frame, further comprising biasing means for generating a frictional force to prevent the bicycle pump from sliding down the saddle post into the bicycle frame, the biasing means being generated by the flexible material and shape of a handle of the air pump, the handle being able to change it's outer diameter to suit the inner diameter of any saddle post, so that the pump is prevented from sliding down the post due to the frictional force generated between the handle and

the saddle post;

Another object of the present invention is to provide an air pump which can easily be inserted and removed from the inside of the bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, regardless of the size and make of the bicycle frame, further comprising means for clamping the air pump unto the extending end of the saddle post;

Another object of the present invention is to provide an air pump which can easily be inserted and removed from the inside of the bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, regardless of the size and make of the bicycle frame, further comprising means for clamping the air pump unto the extending end of the saddle post, the clamping means comprising a pair of flexible legs integrally formed on an extending end of the handle of the air pump, for clamping onto an extending end of the saddle shaft;

Another object of the present invention is to provide an air pump which can easily be inserted and removed from the inside of the bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, the outer diameter of the air pump being slightly less than the inner diameter of the saddle post and the length of the air pump being substantially the same as the bicycle frame portion into which the saddle post slides into, the length and outer diameter of the air pump being specifically made by the manufacturer to specifically fit inside each type of bicycle, whereby the air pump would not hinder the lowering of the saddle to its lowest possible position, thereby providing for a relatively long air pump and for the easy removal of the air pump from the frame portion inside which it is stored.

Another object of the present invention is to provide a bicycle foot air pump (i.e. an air pump one end of which is pressed against the ground while the other end having a handle portion which is moved up and down by hand to pump air into a tire) which is simple in structure, easy to manufacture, requires very few parts, and

which is easy and cheap to assemble;

Another object of the present invention is to provide a bicycle air pump which is simple in structure, easy to manufacture, requires very few parts, is easy and cheap to assemble and which is substantially cylindrical in shape, so that it can fit inside a bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into;

Another object of the present invention is to provide a bicycle foot air pump which is simple in structure, easy to manufacture, requires very few parts, and which is easy and cheap to assemble and which is substantially cylindrical in shape, so that it can fit inside a bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, further comprising biasing means for generating a frictional force to prevent the bicycle pump from sliding down the saddle post into the bicycle frame, where it would be difficult to get out of, the biasing means being generated by the flexible material and shape of a handle of the air pump, whereby the handle can change it's outer diameter to fit inside the inner diameter of most saddle post presently used on bicycles, so that the pump is prevented from sliding down the post due to the frictional force generated between the handle and the saddle post or frame portion into which the saddle post slides into;

Another object of the present invention is to provide a bicycle foot air pump which is simple in structure, easy to manufacture, requires very few parts, and which is easy and cheap to assemble and which is substantially cylindrical in shape, so that it can fit inside a bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, further comprising biasing means for generating a frictional force to prevent the bicycle pump from sliding down the saddle post into the bicycle frame, where it would be difficult to get out of, the biasing means being generated by the flexible material and shape of a foot rest which extends out of a lower part of the pump, so that the pump is prevented from sliding down the post due to the

frictional force generated between the foot rest and the saddle post;

Another object of the present invention is to provide a bicycle foot air pump which is simple in structure, easy to manufacture, requires very few parts, and which is easy and cheap to assemble and which is substantially cylindrical in shape, so that it can fit inside a bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, further comprising means for attaching the air pump to an extending end of the saddle post;

Another object of the present invention is to provide a bicycle foot air pump which is simple in structure, easy to manufacture, requires very few parts, and which is easy and cheap to assemble and which is substantially cylindrical in shape, so that it can fit inside a bicycle saddle post and/or the bicycle frame portion into which the saddle post slides into, further comprising means for attaching the air pump to an extending end of the saddle post;

Another major object of the present invention is to provide a bicycle foot air pump which has the end furthest from the handle end formed have a concave shaped surface, so that the concave end can be placed against the inner surface of a rim of a bicycle wheel when pumping air into the tire, whereby the pump will not slip of the rim due to the concave shape of the end of the air pump fitting around the round inner shape of the bicycle rim, thereby allowing the air pump to be positioned close to the bicycle tire air valve and avoiding dirty situations such as dirty and wet roads.

Another major object of the present invention is to provide of a bicycle flat tire fixing kit and case therefore which can slidingly fit inside the saddle post and or the bicycle frame portion into which the saddle post slides into.

Another major object of the present invention is to provide a bicycle flat tire fixing kit and case therefore which can slidingly fit inside the saddle post and or the bicycle frame portion into which the saddle post slides into, the case being substantially cylindrical in shape and providing means for opening the case so that

the parts stored therein can be removed therefrom;

Another major object of the present invention is to provide a bicycle foot or hand air pump which has few parts, is easy to manufacture and assemble and which is very cheap.

Another major object of the present invention is to provide a foot or hand air pump which fits all the way down the inside of the bicycle frame pipe into which the saddle post fits into, thereby preventing the possibility of the air pump siding down inside the frame pipe, which would make it difficult to remove, and allowing for the manufacture and storage of a longer air pump at substantially very little increase in cost (only the length of the outer cylinder and inner cylinder plunger need be increased).

Another major object of the present invention is to provide a foot or hand air pump having a minimal number of parts, and which is cheap and easy to manufacture, easy to assemble and simple to use.

Another major object of the present invention is to provide and a foot or hand air pump which has connector for attaching the to a bicycle tire valve which can be screwed onto the tire air valve without having to turn the whole pump with it.

Another major object of the present invention is to provide and a foot or hand air pump which includes additional parts, such as rubber spunges, metal or plastic springs, mounted on the outer surface of the air pump which are flexible and allow for insertion into the frame pipe and which prevent the pump from moving, sliding down and/or vibrating inside the frame pipe.

Another major object of the present invention is to provide a bicycle foot or hand air pump which has some parts thereof providing more than one function, such as for facilitating the pumping of air as well as supporting the pump inside the bicycle frame as well as facilitating the fixing of a flat tire.

Another major object of the present invention is to provide a bicycle foot or

hand air pump which has the end furthest from the handle end formed to be in the shape of a concave surface so that the concave end can be placed against the inner surface of the rim when pumping air into the tire, whereby the pump will not slip of the rim.

Another major object of the present invention is to provide a bicycle foot or hand air pump which has a piston having a reservoir compartment for storing a lubricant and means to pass the lubricant to an O ring mounted on the piston.

Another major object of the present invention is to provide a bicycle foot or hand air pump which has a piston having two O rings serially mounted thereon for providing better air pumping characteristics.

Another major object of the present invention is to provide a bicycle foot or hand air pump which has an air pressure indicating means for indicating the pressure of the air being pumped into an air tire.

These and other advantages of the present invention will become illuminated from the following drawings and description.

BRIEF DESCRIPTION OF THE DRAWINGS;

Fig 1 shows perspective view of a conventional air pump;

Fig. 2A shows a perspective view of an air pump according to a first embodiment of the present invention;

Fig. 2B shows a perspective view of an air pump handle having a plurality of protrusions according to another embodiment of the present invention;

Fig. 3 shows a side cross sectional view of a bicycle saddle support post 23 and a bicycle frame portion 25 into which the saddle support post 23 slides into having the air pump 11 of Fig. 2A frictionally supported inside according to the present invention;

Fig. 4A shows a side cross sectional view of a bicycle saddle support post 23 and a bicycle frame portion 25 into which the saddle support post 23 slides into

having the air pump 11 of Fig. 2A frictionally supported inside and an air pump support means 34 according to the present invention;

Fig. 4B shows an end view of the support 34 of Fig. 4A;

Fig. 5 shows a side cross sectional view of a bicycle saddle support post 230 and a bicycle frame portion 25 into which the saddle support post 230 slides into having the air pump 11 of Fig. 2A frictionally supported inside according to the present invention;

Fig. 6A shows a perspective view of an air pump support 60 according another embodiment of the present invention;

Fig. 6B shows a side cross sectional view of a bicycle saddle support post 23 having the air pump support 60 mounted therein;

Fig. 6C shows a side cross sectional view of a bicycle saddle support post 23 having the air pump support 60 mounted therein and the air pump 11 of Fig. 2A supported by the support 60;

Fig. 6D shows a perspective view of an air pump support 600 according another embodiment of the present invention;

Fig. 7A shows a side cross sectional view of a bicycle saddle support post 23 and a bicycle frame portion 25 into which the saddle support post 23 slides into having the conventional air pump 1 of Fig. 1 and a biasing means (spring 41) stored therein according to the present invention;

Fig.7B shows a side view of another embodiment of a biasing means 41b which can be used instead of the spring 41;

Fig.8A , shows a side cross sectional view of a bicycle saddle support post 23 and a bicycle frame portion 25 into which the saddle support post 23 slides into having the conventional air pump 1 of Fig. 1 and a biasing means (spring 41) stored therein further including a case 51 for storing bicycle air pump parts;

Fig. 8B shows a perspective view of a first embodiment of the case 51

according to the present invention;

Fig. 8C shows a perspective view of another embodiment of the case 51 according to the present invention;

Fig. 9A shows a front view of a foot-hand air pump 111 with the handle 71 thereof in the vertical position (i.e. air pump storage position) according to the present invention;

Figs. 9B and 9C show a side view and end view of a foot-hand air pump 111 of Fig. 9A with the handle 71 thereof in the horizontal position (i.e. air pumping position);

Fig. 9D shows a side cross sectional view of the saddle support post 23 locked inside the frame portion 25 with the foot-hand air pump 111 stored inside the saddle support 23 and frame portion 25 according to the present invention;

Figs. 10A-10E show a perspective view, a top view, a bottom view, a front view and a side view of the handle 71 according to the present invention;

Fig. 10F shows a side cross sectional view of the handle 71 at line I-I in Fig. 10D;

Figs. 10G-10H show a side cross sectional view of the handle 71 at line I-I in Fig. 10D, with the handle 71 being mounted on the handle support section 73, the handle 71 being in the air pump storage position (i.e., vertical position) and in the air pumping position (i.e., horizontal position), respectively;

Fig. 10I shows a perspective view of another embodiment of a handle 710 for the foot-hand air pump 111 according to the present invention;

Fig. 10J shows perspective view of another embodiment of the handle 710 for the foot-hand air pump 111 according to the present invention;

Fig. 10K shows a front view of a bicycle air tube conventional fixing patch;

Figs. 11A-11C show a perspective view, a top view and a bottom view, respectively, of the handle support 73 according to the present invention;

Fig. 11D shows a side cross sectional view of the handle support 73 at line I-I of Fig. 11B;

Fig. 11E shows a side view of a sheet of steel 431 before rolling it into a shaft;

Figs. 11F-G show a side view and top view of the sheet steel 431 after being pressed and rolled into a shape of a round shaft 431c with a pair of round protrusions 431p according to the present invention;

Figs 11H shows a perspective view of a sheet of metal which has been pressed and rolled to form a handle 432a according to the present invention;

Fig. 11I shows a front view of a sheet of metal 433 before rolling it into a handle;

Figs. 11J show a perspective view of the sheet metal 433 which has been pressed and rolled to form another handle 433a according to another embodiment of the present invention;

Fig. 11K-L show end views of the sheet metal 431 pressed and bent to form a shaft having a square cross section and U cross section according to the present invention;

Fig. 11M shows a front view of a sheet of metal 444 before rolling and pressing it into a handle 444a;

Fig. 11N shows a perspective view of the sheet metal 444 after it has been pressed and rolled to form another handle 444a according to another embodiment of the present invention;

Fig. 11P shows a side cross sectional view at line I-I in Fig. 11N of the handle 444a;

Fig. 11Q shows a perspective view of the shaft 431c of Fig. 11F;

Fig. 11R shows a perspective view of a sheet of metal after it has been punched and pressed to form another handle 444a according to another embodiment of the present invention;

Figs. 12A-12D show a perspective view, side view, top view and a bottom view of the end cap 74 according to the present invention;

Fig. 12E shows a side cross sectional view of the end cap 74 at line I-I of Fig. 12C;

Figs. 13A-13F show a perspective view, a side view, a top view, a bottom view, a front view and a back view of the air outlet portion according to the present invention;

Fig. 13G shows a side cross sectional view at line I-I of Fig. 13C;

Figs. 13H-I show a side view and front view of the air outlet portion 75 with a flexible tail portion 75t thereof twisted around the bottom of the air outlet portion 75 with a round extending end 75e of the tail 75t locked in a hole 75h;

Fig. 13J and 13K show a bottom view of the air outlet portion 750 and a perspective view of a tail portion 751 according to another embodiment of the present invention;

Fig. 13L shows a side cross sectional view of the air outlet portion 750 according to another embodiment of the present invention;

Fig. 13M shows a perspective view of a female connector 700 used with the air outlet portion of Fig. 13L;

Fig. 13N shows an enlarged perspective view of a rubber disc 751 used as a one way air valve in Fig. 13L;

Fig. 13O shows an enlarged side view of a disc 751 shown in Fig. 13N;

Fig. 13P shows a side cross sectional view of the air outlet portion 750 of Fig. 13L without the female connector 700 and disc 751assembled therein;

Figs. 14A-14C show a side cross sectional view, a top view and a bottom view of the foot-hand air pump 111 according to the present invention;

Figs. 15A and 15B show a side view and a side cross sectional view of conventional male and female connectors 7a and 7b having respective ends thereof

mounted in a nylon tube 7n according to an embodiment of the present invention;

Fig. 15C shows a side cross sectional view of a female connector 77b mounted in a nylon tube 7n according to another embodiment of the present invention;

Fig. 15D-15F show a side cross sectional view, a side view and a side view of the first, second and third portions 801, 802, 803 of the connector 77b before the assembly of the connector according to the present invention;

Figs. 15G and 15H show a front and back view of a first part 801 of the connector 77b;

Fig. 15I shows a front view of the second portion of the connector 77b;

Figs. 15J and 15K show a front and back view of the third portion of the connector 77b;

Fig. 16A-16C show a side view, a front view and a back view of a piston 76;

Fig. 16D shows a side cross sectional view of the piston 76 at line I-I of Fig. 16B;

Figs. 17 A-C show a side view, a front view and a back view of a piston 83 having a lubrication reservoir tank 83r according to the present invention;

Fig. 17D shows a side cross sectional view of the piston 83 at line I-I of Fig. 17B;

Figs. 18 A-C show a side view, a front view and a back view of a piston 84 according to another embodiment of the present invention;

Fig. 18D shows a side cross sectional view of the piston 83 at line I-I of Fig. 18B inside a cylinder 70;

Fig. 18E shows a front view of a piston 840, further including an oil lubrication apparatus 840r according to another embodiment of the present invention;

Fig. 18F shows a side cross sectional view of the piston 840 at line I-I of Fig. 18E;

Fig. 19A shows a side cross sectional view of a foot-hand air pump 1111 similar to the air pump 111 of Figs. 14A-14C, further including a pressure indicating gauge according to the present invention;

Fig. 19B shows perspective view of a handle 710 of the air pump 1111 according to the present invention;

Fig. 19C shows perspective view of a handle support 730 of the air pump 1111 according to the present invention;

Figs. 20A, B show perspective views of a cap 761 and extension means 762 for the air pump 1111 according to another embodiment of the present invention;

Fig. 20C shows a side cross sectional view of the cap at line I-I of Fig. 20A with the extension means 762 mounted therein according to the present invention;

Fig. 20D shows a side cross sectional view of a foot-hand air pump 11111 similar to the air pump 1111 of Figs. 19A including a pressure indicating gauge according to another embodiment of the present invention;

Fig. 21A-C show a side view, a top view and a bottom view of first part of an air pressure indicating device according to another embodiment of the present invention;

Fig. 21D shows a side cross sectional view of the first part 210 at line I-I of Fig. 21B;

Fig. 21E shows a side cross sectional view at line I-I of Fig. 21B further including the rest of the air pressure indicating device according to the present invention;

Fig. 21F-G show a front and back view of the end cap 211 of the pressure indicating device;

Fig. 21H shows a side view of an air pressure piston 212 of the pressure indicating device;

Figs. 22A-B show a top view and a bottom view of an air pressure

measuring/indicating device according to the present invention;

Fig. 22C shows a side cross sectional view at line I-I of the air pressure measuring/indicating device of Fig.22A;

Figs. 22D-E show a front view and back view of a Schrader valve opening means 311 of Fig. 22C; and

Fig. 22F-G show a front view and back view of an round rubber sleeve 312 of Fig. 22C.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig 1 shows front view of a conventional air pump. Referring to the Fig., numeral 1 designates a conventional hand held air pump, numeral 2 designates a cylindrical body, numeral 3 designates a fixed handle which is formed of plastic or metal mounted on one end of a cylindrical metal hollow shaft 4, the other end of the shaft 4 being connected to an air piston (not shown) provided for compressing and pushing air into a bicycle tire (not shown) according to conventional methods well know in the art. Numeral 5 designates an end cap which is screwed into one end of the cylinder 2. The end cap 5 has a central through hole 5a formed therein for receiving and supporting the shaft 4 therethrough and for allowing air to pass therebetween. Numeral 6 designates a rubber pipe having a male connector 7a and a female connector 7b mounted on respective ends thereof, connector 7a having a male portion thread (not shown) which is screwed into a female connecter insert (not shown) mounted along the bottom of the cylinder 2 and connector 7b having a female thread portion (not shown) which can be screwed onto a conventional bicycle air valve (not shown). The pipe 6 and the connector 7a slidingly fit into the central hole 4a inside the center of the shaft 4 for storage therein.

Fig. 2A shows a perspective view of an air pump according to a first embodiment of the present invention. Referring to the Fig., numeral 11 generally designates an air pump which is substantially the same as the conventional air pump

of Fig. 1, with the following differences. Numeral 33 designates a handle which is substantially the same as the handle 3, but also includes a flexible plastic ring 33a integrally formed therewith along the top outer surface of the handle 33, the ring 33a having an outer peripheral width greater than the diameter of the handle 33. Numeral 33b designates a pair of tooth shaped protrusions formed along the outer sides of the ring 33a. The purpose for the ring 33a will be described herebelow.

Fig. 3 shows a side cross sectional view of a bicycle saddle support post 23 and a bicycle frame portion 25 into which the saddle support post 23 slides into having the air pump 11 of Fig. 2A frictionally supported inside according to the present invention. Referring to the Fig., numeral 24 designates a saddle mounted on the saddle support post 23 using conventional means, numeral 25 designates a saddle support frame portion of a conventional bicycle frame, numeral 26 designates a conventional quick release latch commonly found on bicycle frames which has a pressure applying handle 26a which can be manually turned to lock or release the bicycle saddle support post 23 in the frame portion 25, so that the saddle support post 23 and saddle 24 can be raised or lowered to any desired height or completely taken out from the saddle support frame portion 25.

As can be seen from Fig. 3, the outer diameter of the air pump 11 is less than the inner diameter of the saddle support 23, which would normally result in the air pump 11 sliding down to the bottom of the frame portion 25 due to gravity. However, since the peripheral width of the ring 33a is greater than inner diameter of the saddle support post 23 and the diameter of the frame portion 25, the ring 33a generates a frictional force against the inner walls of the saddle support post 23, thereby preventing the air pump 11 from sliding down the saddle support post 23 into the frame portion 25, where it would be difficult to remove. Namely, the outer sides of the flexible ring 23 push against the inner walls of the saddle support post 23, regardless of the size and make of the saddle support post 23 or the bicycle frame

portion 25. Accordingly, due to the flexible nature of the ring 33a, and due to the flexible ring 23a having an outer peripheral width greater than that of the saddle support post 23 or the frame portion 25, the ring 33a generates a frictional force which prevents it, and, accordingly, the air pump 11 from sliding down the saddle support post 23 into the frame portion 25, where it would be difficult to remove. Accordingly, the flexible ring 33a provides a frictional force generating means for generating a frictional force to prevent the bicycle pump from sliding down the saddle post into the bicycle frame, where it would be difficult to get out of. Furthermore, the tooth like protrusions 33b provide an increased frictional force, since all the elastic force generated by the ring 33b is applied over a very small area.

To insert the air pump 11 inside the post 23, first the post 23 is removed from the frame portion 25, then the pump 11 is pushed into the post 23, which forces the flexible ring 33a to be squeezed and frictionally slide into and fit inside the post 23. The frictional force between the inner walls of the post 23 and the ring 33a is sufficient to prevent the pump 11 from sliding out of the saddle support post 23 and into the frame portion 25, where it would be difficult to remove. The handle 33 can be formed of plastic using conventional plastic injection molding techniques. The ring 33a can be formed to have a given width and thickness as well as diameter to provide the desired frictional characteristics for a given plastic material used in the manufacture of the handle 33.

Fig. 2B shows a perspective view of an air pump handle 330 having a plurality of protrusions according to another embodiment of the present invention. Referring to the Fig., numeral 330 designates a handle similar to the handle 3, but also including a plurality of radially outwardly facing finger like protrusions 330b which are integrally formed along the circumferential bottom surface of the handle 330. The protrusions 330b act similarly to the ring 33b in that they provide a biasing frictional force when the handle 330 is inserted into the saddle support post 23.

Fig. 4A shows a side cross sectional view of a bicycle saddle support post 23 and a bicycle frame portion 25 into which the saddle support post 23 slides into having the air pump 11 of Fig. 2A frictionally supported inside and an air pump support means 34 according to the present invention. Fig. 4B shows an end view of the support 25. Referring to the Figs., the support means 34 comprises a plastic or nylon cylinder. The cylinder 34 is very thin, light and cheap, such as that used for making straws used for drinking juice out of cans and can be sold together with the pump as a set. The user of the bicycle can use a pair of scissors (not shown) to cut the support 34 to the desired length for his or her specific bicycle, so that the saddle support post 23 can be lowered all the way into the post 25 incase the user of the bicycle is very short in stature. Namely, the combined length of the air pump 11 and the support 34 is equal to the length of the frame portion 25. To minimize the cost of the pump and to minimize the size of the packaging required for the pump for the purpose of displaying it on a shelf of a store, the support 34 can be the actual vacuum-formed transparent plastic box used for packaging the pump, whereby the user need only cut out a semicircular portion from the rest of the packaging box and also cut it to the desired length with a pair of scissors.

It should be noted that instead of the cylindrical support 34 a square support or simply a flat plate (not shown) may be used to support the pump 1 from sliding down the frame portion 25.

Fig. 5 shows a side cross sectional view of a bicycle saddle support post 230 and a bicycle frame portion 25 into which the saddle support post 23 slides into having the air pump 11 of Fig. 2A frictionally supported inside according to the present invention. Referring to the Fig., it can be seen that the saddle support post 230 is the same as the saddle support post 23 with the only difference being that the extending end 230a thereof is tapered. This type of saddle post is commonly used with cheaper model bicycles. As can be seen from the Fig., the air pump 11 is

partially pushed into the saddle support post 230 until the protrusions 33b slide inside the tapered portion 230a of the saddle support post 230, whereby the protrusions 33b not only provide friction generating means, but also perform as latching means for preventing the air pump from sliding out of the saddle support post 230.

Fig. 6A shows a perspective view of an air pump support 60 according to the present invention. Referring to the Fig., numeral 61 designates a semi-cylindrical main body portion which is formed of springy type sheet metal, numeral 62 designates a plurality of outwardly facing tooth like protrusions, numeral 63 designates a semi circular groove formed in the radial direction of the semi cylindrical main body portion 61 along one end thereof. To manufacture the air pump support 60, first a square piece of sheet metal is punched out of a large sheet of metal as well as punching out the tooth like protrusions 62 and pressing the groove 63. Next, the square piece of sheet metal is past by a set of rollers to change it from a flat shape to that shown in Fig. 6a. This process is well known in the art of sheet metal cold press forming.

Fig. 6B shows a side cross sectional view of a bicycle saddle support post 23 having the air pump support 60 mounted therein. Referring to the Fig., the support 60 is mounted inside the extending end of the saddle support 23. To mount the air pump support 60 inside the saddle support post 23, the semi-cylindrical body 61 is pressed inwards until its outer diameter is smaller that the inner diameter of the saddle support post 23, then the support 60 is slid into the open extending end of the saddle support post 23 until the groove 63 is adjacent to the extending end of the saddle support post 23. Since the support 60, in its usual state, has a diameter which is greater than the inner diameter of the saddle support post 23, it exerts a constant outward force against the inner walls of the post 62. The tooth like protrusions provide an additional frictional force for preventing the support 60 from sliding out

of the saddle support post 23.

Fig. 6C shows a side cross sectional view of a bicycle saddle support post 23 having the air pump support 60 mounted therein and the air pump 11 of Fig. 2A supported by the support 60. Referring to the Fig., the air pump 11 is supported by the support 60. More specifically, by pushing the air pump 11 into the saddle support post 23 until the protrusions 33b fit into the groove 63, or alternatively, by pushing the air pump 11 all the way into the saddle support post 23 or, as is shown in the Fig., namely, above the top surface of the support 60, the support 60 provides the function of a support means or clamping means or latch means for preventing the pump 11 from sliding out of the saddle support post 23.

Fig. 6D shows a perspective view of an air pump support 600 according another embodiment of the present invention. Referring to the invention, the support 600 is very similar to the support 60 and the only difference is that the support 600 further includes a plurality of inwardly facing finger like protrusions 601 which have been punched out of the sheet of metal similar to the outwardly facing protrusions 62. Each of the protrusions 601 is rectangular in shape and is bent along a central portion thereof so that the extending end of each protrusion 601 is facing outwardly towards the cylindrical wall. Accordingly, with this type of air pump support 600, not only is a constant outward frictional force generated by the protrutions 62 against the inner surface of the saddle support shaft 23, but also an inward force is generated by the inwardly facing finger like protrusions 601 against a handle of an air pump which is inserted therebetween. With this type of support 600, not only is the frictional force on an air pump supported between the plurality of finger like protrusions increased, but also the air pump supported therebetween can be of varying diameters and any conventional air pump may be supported therebetween.

Fig. 7A shows a side cross sectional view of a bicycle saddle support post 23 mounted in a bicycle saddle post frame portion 25 having a conventional air pump

11 and a spring 41 stored therein according to the present invention. Referring to the Fig., numeral 41 shows a conventional spring 41 placed inside the frame portion 25. The spring 41 acts as a biasing means or as a bicycle air pump storage-dispensing device for pushing a conventional air pump such as shown by the pump 1, or any of the air pumps according to the present invention, against the inside upper surface of the post 23. Alternatively, if the diameter of the pump 1 is greater than the inner diameter of the saddle support post 23 but less than the inner diameter of the frame portion 25, against the extending end 23e of the saddle support post 23. According to this embodiment, first the saddle support post 23 is removed from the frame portion 25, next the spring 41 is inserted (i.e., dropped) into the frame portion 25, next the conventional air pump 1 or any of the pumps according to the present invention is inserted into the pipe portion 25 and then the saddle support post 23 is inserted into the frame portion 25. Accordingly, the spring 41 pushes against the bottom of the air pump 1 causing the top of the air pump 1 to push against the upper inside surface 23u of the post 23. The pressure applying handle 26a is then turned to lock the saddle 24 at the desired height for the particular user.

Accordingly, the spring 41 pushes the air pump 11 upwards as high as the air pump can go, whereby not only is the pump 11 and the spring 41 prevented from vibrating during the riding of the bike but also provides for the easy removal of the air pump 11from inside the frame portion 25. Furthermore, the spring 41 acts as a bicycle air pump storage-dispensing device, since it allows for the automatic adjustment of the height of the air pump 1 (i.e. automatically adjusts the size of the "storage" space inside the saddle support post 23 and/or the frame portion 25 regardless of the length and inner diameter of the saddle support post 23, frame portion 25 and the length of the air pump 1) during the storage thereof inside the saddle support post 23 and/or the frame portion 25, while also facilitating for the easy removal (i.e. "dispensing") of the air pump due to the biasing force of the

spring. The spring 41 may be formed from conventional spring steel or from elastic plastic material to reduce the weight thereof. The length of the spring 41 preferably should be less than the length of the frame portion 25, but it should not be shorter than the length required to push at least the top of the air pump 1 past the opening of the frame portion 25. Further, that the spring constant (i.e. F=kS, where F represents force, s represents the distance the spring is compressed and k represents the spring constant) should be just sufficient to push the air pump out of the frame portion, namely, the thinnest spring possible should be used to minimize the weight thereof. Further, that the spring used is of the push type (i.e. its coils are spread out) and not the pull type. Furthermore, when the spring 41 is in a completely compressed state, the length of the compressed spring 41 and the length of the air pump 11 should be less than the length of the frame portion 25.

Fig.7B shows a side view of another embodiment of a biasing means 41b which can be used instead of the spring 41. Referring to the Fig., the biasing means 41b comprises a flat snake like spring made of an elastic plastic material or flexible steel, which can be used instead of the spring 41. One end 41c of the spring 41b is formed in a circular shape to provide for a greater surface area for pushing against the bottom of the air pump 1, so that the air pump 1 does not slide along the side thereof. The other side of the spring 41a can be snipped with a pair of scissors to the desired length by the user. This spring 41a can further reduce the cost of manufacture and the weight thereof.

Fig. 8A shows a side cross sectional view of conventional air pump 1 stored in a bicycle saddle support post 23 and/or bicycle saddle post frame portion 25 according to the present invention, further including a case 51 for storing bicycle air pump parts therein, such as additional connectors for connecting the air pump to different types of air tire valves, as well as for storing flat tire fixing parts. Referring to the Fig., it can be seen that the case 51 is placed between the spring 41 and the air

pump 1. Both the pump 1 and the case 51 are prevented from vibrating during the riding of the bicycle due to the biasing means of the spring 41. When the saddle support post 23 is removed from the frame portion 25, the spring 41 pushes the air pump 1 and the fixing kit case 51 out of the frame portion 25, so that they may be easily accessible.

Fig. 8B shows a perspective view of a first embodiment of the case 51 according to the present invention. Referring to the Fig., numeral 51a designates a cylindrical bottom portion and numeral 51b designates a cylindrical cover for the case 51 which can be pushed onto the top of the bottom portion 51a. The case 51 contains materials and tools for fixing a flat tire such as special spoons to remove the tire, rubber patches for mending a hole in the bicycle rubber tube, glue for applying to the patch if it does not have adhesive material applied on it, sand paper for rubbing the surface of the tube around the hole as well as spare parts such as air valve parts, air valve adapter connectors, etc. The case 51 may further have a sponge inserted inside to prevent the parts stored therein from vibrating and causing noise while a person is riding the bicycle. Accordingly, the outer diameter of the case 51 must be less than the inner diameter of the frame portion 25, so that it may freely move up and down therein.

Fig. 8C shows a perspective view of another embodiment of the case 51. Referring to the drawing, numeral 51c designates a cylindrical case having an opening along the side thereof and numeral 51d designates a lid for closing the case. The case 51c can be used to store bicycle tire fixing tools and fixing parts as well as any other parts. A sponge (not shown) may be included inside the case 51c to dampen any vibration sounds made by the parts inside the case 51c during riding. The spring 41 urges the case 51 and the air pump 1 to be pushed upwards into the space inside the post 23. To use the air pump 1 or case 51, simply take out the saddle support post 23 out of the frame portion 25. The spring 41 will push the

pump 1 and the case 51 out of the frame portion 25, so that they can be used. To store the case 51 and pump 1 simply press down on the spring 41 with the pump 1 and insert the saddle support post 23 back into the frame portion 25.

Fig. 9A shows a front view of a foot-hand air pump 111 with the handle 71 thereof in the vertical position (i.e. air pump storage position) according to the present invention. Figs. 9B and 9C show a side view and end view of a foot-hand air pump 111 of Fig. 9A with the handle 71 thereof in the horizontal position (i.e. air pumping position). Most bicycle air pumps can be divided into two types. The first type is the one held by both the left and the right hand and moving the hands towards each other forces air out of the air pump, hereafter referred to "as hand air pump". The other type of air pump is the one where one end of the pump is pressed against the ground by a foot and the other end (i.e. the handle 71) of the air pump is pushed by hand towards the end pressed against the ground, hereafter referred to as "foot-hand air pump".

As is well known, it is much harder to use a hand air pump than to use a foot-hand air pump since both hands are required in a hand pump, one hand pushing against the other to pump air, while in the foot-hand air pump, one or both hands is/are used to push the handle to pump air while the other end of the air pump is pressed against the ground. However, foot-hand air pumps are generally much larger than hand pumps and have many protruding part. Accordingly, it would not be possible to insert and store a foot-hand air pump inside the frame of a bicycle. Therefore, it is very desirable to have a foot-hand air pump, which are much more efficient when it comes to pumping air, which has a small outer diameter and can be stored inside the saddle support post 23 and/or the frame portion 25 into which the saddle support post 23 slides into.

One major object of the present invention is to provide a foot-hand air pump 111 which is substantially cylindrical in shape and having no protruding portions, so

that the foot-hand air pump 111 can be stored inside the bicycle frame. Furthermore, although the foot-hand air pump 111 is limited to a relatively small diameter, it still provides a relatively large volume of pumped air for each pumping stroke for its relative size, because, although limited to a small diameter, it can be made as long as the length of the frame portion 25 and still allow the saddle to be lowered to its lowest position in case a short person is riding the bicycle.

Referring to Figs. 9A-9C, numeral 70 generally designates a cylindrical body, numeral 72 designates a cylindrical hollow shaft, numeral 73 generally designates a handle support which is mounted on an outwardly extending end of a cylindrical hollow shaft 72, the other end of the shaft 72 being connected to an air piston 76 (see Fig. 14A) which is provided for compressing and pushing air into a bicycle tire (not shown) according to conventional methods well know in the art. Numeral 74 designates an end cap which is screwed into one end of the cylinder 70. Numeral 75 generally designates air outlet portion which is connected to the other end of the cylinder 70. Numeral 71 generally designates a handle which is formed of plastic or sheet metal, the handle 71 being pivotally mounted on the handle support 73 as will be explained later.

Figs. 11A-11D show a perspective view, a top view and a bottom view and a side cross sectional view at line I-I of Fig. 11B, respectively, of the handle support 73 according to the present invention. Referring to the Figs., the handle support 73 comprises a central shaft portion 73a having a through hole 73h for frictionally receiving the extending end of the shaft 72 therein and a pair of handle support shafts 73s integrally formed with the cylindrical portion 73a along diagonally opposed outer sides thereof. The handle support 73 further comprises a ring shaped portion 73r formed along one end of the shaft 73a along an inner surface thereof for preventing the handle support from sliding down the shaft 72. The handle support 73 is frictionally mounted on the shaft 72 by pushing the outwardly extending end of

the shaft 72 into the hole 73h until the extending end of the shaft 72 buts up against the inner side of the ridge 73r. Alternatively, the handle support 73 may be glued onto the extending end of the shaft 72, so that it is permanently fixed thereto. The handle support is preferably made of plastic or a nylon material using conventional injection molding techniques.

Figs. 10A-10E show a perspective view, a top view, a bottom view, a front view and a side view of the handle 71 according to the present invention. Fig. 10F shows a side cross sectional view of the handle 71 at line I-I in Fig. 10D. Figs. 10G-10H show a side cross sectional view of the handle 71 at line I-I in Fig. 10D, with the handle 71 being mounted on the handle support section 73. In Fig. 10H, the handle 71 is in the air pumping position (i.e., horizontal position) and in Fig. 10G the handle 71 is in the air pump storage position (i.e., vertical position). Referring to the Figs., the handle 71 comprises a substantially semi-cylindrical body 71b, the open side of the semi-cylindrical body allowing the handle 71 to swivel about the shaft 72 from a vertical position (i.e. air storage position) to a horizon position (i.e. air pumping position) as well as to allow the semi-cylindrical body 71b to be squeezed inwardly, whereby the facing edges 71e thereof are pressed towards each other, so that the outer diameter of the cylindrical body 71b and, accordingly, the handle 71 is reduced. Numeral 71p designates a plurality of round protrusions integrally formed along the outer side of the handle 71 in the radial direction thereof near the extending end (i.e. the end where the wall 71w is formed) of the handle 71. The protrusions 71p serve to further increase the anti-slide frictional characteristics of the air pump 111 when the air pump 111 is stored inside the saddle post 73. The handle 71 is made of plastic, nylon or any other suitable material using conventional injection molding techniques. Numeral 71h designates a pair of through holes made at diagonally opposing sides of the handle 71 for receiving the handle support shafts 73s therein. The diameter of the holes 71h is the same as or slightly greater than the

outer diameter of the shafts 73s, so that the handle 71 can be mounted on the shafts 73s and swivel thereon. To mount the handle 71 on the handle support 73, facing edges 71e of the handle 71 are manually pulled away from each other until the distance between the holes 71h is large enough to allow the shafts 73s to fit therebetween. Then, the facing edges 71e are released to allow the shafts 71s to slidingly fit into the holes 71h. The extending ends 73e of the handle support shafts 73s may be formed to be slightly larger in diameter, so that they provide a better gripping characteristics for the handle 73.

Numeral 711 designates an inwardly facing tooth shaped ridge or latch (hereinafter referred to as female locking portion) formed along the inner bottom circumferential edge of the handle 71 for locking the handle 71 to the cap 74 as will be explained later. Numeral 71w designates a wall integrally formed along the extending end of the semi-cylindrical body 71b of the handle 71 in the radial (i.e., horizontal) direction thereof. Numeral 71s designates a through hole formed in the center of the wall 71w for frictionally supporting the connector 7b and the pipe 6 therein. Numeral 71v designates a V shaped slot formed in the wall 71w, starting from the periphery of the wall 71w and extending to the through hole 71s, the open section of the semi-cylindrical body 71b and the periphery of the V shaped slot 71v coinciding with each other. Accordingly, the slot 71v serves for easily guiding the pipe 6 and the connector 7b into the hole 71s for being frictionally supported therein. Also, since the wall 71w and the semi-cylindrical body 71b are formed of flexible material, they can be squeezed by hand to fit in and frictionally slide inside the saddle support post 23. Accordingly, the male connector 7a and the hose 7n can be stored inside the shaft 72 by passing them through the hole 73h in the handle support 73 and the female connector 7b or 77b can be frictionally supported in the hole 71s.

One major advantage of having the connector 7b supported in the hole 71s in the wall 71w and having the connector 7a and the hose 7n supported inside the shaft

72 is that, if the user turns the handle from the storage position (i.e. vertical position) to the air pumping position (i.e. horizontal position), the handle 71 will not be damaged or brake, since the hose 7n is flexible and will bend with the turning action of the handle 71. Furthermore, since the connector 7b extends above the extending end of the handle 71, it is easy to access as well as to mount or remove from the handle 71. Still further, the semi-cylindrical handle 71 and, accordingly, the female locking portion 711, have a circumference less than 360 degrees but more than 180 degrees and, thereby not only providing handle locking (latch) means for locking the handle 71 in the vertical position (i.e. the handle 71 is locked in the male latch portion 741, so that the handle 71 and the shaft 72 cannot be pulled out of the cylinder 70), but also providing handle anti-swivel latch means (i.e., the horizontal position), so that some force must be exerted on the handle 71 to cause it to swivel with respect to the cylinder portion 70. Namely, when rotating the handle from the vertical position to the horizontal position, some force must be manually exerted to separate (i.e., unlatch) the male and female locking portions 741 and 711 from each other.

Fig. 9D shows a side cross sectional view of the saddle support post 23 locked inside the frame portion 25 with the foot-hand air pump 111 stored inside the saddle support 23. Referring to the Fig., to insert the foot-hand air pump 111 inside the saddle post, the foot-hand air pump 111 is manually pushed into the saddle support 23 while the handle 71 is in the vertical locked position. However, since the diameter of the handle 71 is larger than the inner diameter of the saddle support 23, the handle 71 must be first squeezed inwardly causing the facing edges 71e of the handle 71 to move towards each other, and then pushed inside the saddle support post 23. Accordingly, since the handle 71 is made of a flexible material, the handle 71 exerts a constant outward force on the inner walls of the saddle support 23 to stop to handle 71, and accordingly, the foot-hand air pump 111 from sliding down the

saddle support 23. Further, the round protrusions 71p create increased anti-sliding frictional characteristics for the air pump 111. Still further, the tail sections 75t and round portion 75e are deformed to fit the inside of the frame support section 25, thereby preventing rattling of the air pump 111 as well as providing an additional anti-sliding frictional force for preventing the foot-hand air pump 111 from sliding down the frame portion 25.

It should be noted that the shafts 73s of the handle support 73 can be formed to have a length which is slightly smaller than that shown in Fig. 14A, so that the distance between the extremities of the shafts 71s is less than the outer diameter of the handle 71 to facilitate the above desired air pump storing characteristics. In this case the thickness of the inner walls around the holes 71s can be increased (i.e. flanged) to provide better handle support characteristics by the shafts 73s.

It should be further noted that the handle 71 can be formed to have the extending end thereof (i.e. the end having the wall 71w) tapered, so that the extending tapered end of the handle 71 has a smaller outer diameter than the rest of the handle as well as a smaller diameter than the inner diameter of the support shaft 23, whereby the tapered extending end of the handle 71 can be easily inserted into the saddle support 71, and then, the larger diameter portion of the handle 71 must be pushed into the saddle support (i.e. by holding the cylindrical portion 70 and pushing the air pump 111 into the saddle support 111), thereby simplifying the insertion of the air pump into the saddle support 23.

Fig. 10I shows a perspective view of another embodiment of the handle 710 for the foot-hand air pump 111 according to the present invention. The portions of the handle 710 which are the same as those in the handle 71 will be designated by the same numerals. Referring to the Fig., numeral 710f designates a tongue like flange which is integrally formed with the body portion 710b along the extending end thereof above the wall 71w. The base of the flange 710f partially extends along

the circumference of the top of the wall 71w and the extending end of the flange 710f is less wide than it is at its base, so that the flange may be used as a tool to remove a bicycle tire (not shown) in order to fix a puncture in a rubber tube (not shown) inside the tire. The thickness of the flange is greater than the walls of the handle body 710b for providing extra strength for removing the bicycle tire from a rim (not shown) of a wheel (not shown). Accordingly, the flange 71f can be used for removing a tire from a rim (not shown) in order to fix a flat tire. Numeral 710r designate two pairs of inwardly facing ridges formed on the inner surface of the main body 710b along the facing edges 71e. The ridges 710r and the inner surface of the wall 710b between the ridges 710r serve to support a rubber patch 81 (shown in Fig. 10K), which is commonly available and well know in the art.

Fig. 10K shows a front view of a rubber patch 81which has an adhesive compound pre-applied to one side thereof. The patch 81 has a vinyl seal 82 applied to one side thereof for keeping the adhesive compound fresh thereunder. Since the rubber patch 81 is made of rubber, it can be bent to fit the curvature of the inside of the handle 710, and by choosing the right length l and width w, as shown in Fig. 10K, for the patch 81, it can be made to fit between the wall 71w and the holes 71h of the handle 710 along the length l thereof and between the respective two sets of inwardly facing ridges 71r. The elastic nature of the patch 81 will ensure that it is permanently stored along the inner walls of the handle 710, until such time as the user decides to manually pull it out for fixing a flat tire.

Fig. 10J shows perspective view of another embodiment of the handle 711 for the foot-hand air pump 111 according to the present invention. The portions of the handle 711 which are the same as those in the handle 710 will be designated by the same numerals. Referring to the Fig., numeral 711 generally designates the handle, numeral 711b designates a semi-elliptical body portion (instead of the semi-cylindrical body portion 71a). The elliptical shape of the handle 711 provides for

better anti-slide friction characteristics inside the saddle post 23.

Figs. 12A-12E show a perspective view, side view, top view, bottom view and cross sectional view at line I-I of Fig. 12C of the end cap 74 according to the present invention. Referring to the Figs., numeral 74s designates a cylindrically shaped body having a through hole 74h formed through the center thereof for receiving and slidingly supporting the shaft 72 therein and for allowing air to pass therebetween. Numeral 74t designates a thread portion formed at one end of the outer wall of the cylindrical body 74s, numeral 74r designates a ridge formed along the outer wall of the cylindrical body 74s, and numeral 74l designates an outwardly facing tooth shaped ridge (hereinafter referred to as male locking portion) formed along the other end of the outer wall of the cylindrically shaped body 74s. The outer surface of the cylindrical body 74s between the ridge 74r and male locking portion 74l provides room for allowing the female locking portion 71l to fit in when the handle 71 is in the vertical position. Accordingly, moving the handle 71, while being in the vertical position (as shown in Fig. 10G), towards the cap 74, and pushing the handle 71 against the cap 74, causes the female locking portion 71l (i.e. the inwardly facing tooth shaped ridge 71l) of the handle 71, to spread, due to the elastic nature of the handle 71, allowing the female locking portion 71l to pass over the male locking portion 74l of the end cap 74 to lock the handle 71 with the end cap 74. To unlock the handle 71 from the cap 74, the handle 74 is turned from the vertical position (i.e. as shown in Fig. 10G) to the horizontal position (i.e. as shown in Fig. 10H).

It should be noted that when the piston 76 is pushed all the way into the cylinder 71 (i.e. at the end of the air pumping stroke) by the shaft 72, the portion of the shaft 72 still extending outside the air pump 111 (i.e. above the end cap 74) should be just long enough to allow the male and female locking portions 74l and 71l of the cap 74 and handle 71 to lock.

Fig. 11E shows a front view of a sheet of steel before rolling it into a shaft.

Figs. 11F-G show a front view and end view of the sheet steel after being pressed and rolled into a shape of a round pipe with a pair of round protrusions 431p. Fig. 11Q shows a perspective view of the shaft 431c of Fig. 11F. Referring to the Figs., a large sheet of metal (not shown) is first punched and pressed to cut it into smaller sheets of metal 431having a desired length and width, using conventional cutting and pressing machines well known in the art, the pressing operation forming the two protrusions 431p. Next, the sheet of metal 431 with the two protrusions 431p is rolled to form a cylindrical shaft 431c having two protrusions 431p located at diagonally opposing sides thereof and a seam 431s running along the length thereof. Alternatively, instead of rolling the sheet metal 431 into a cylinder as shown in Fig. 11G, it can be pressed into a square shape as shown by the end view in Fig. 11k or into a U shaped beam as shown by the end view in Fig. 11L and can be used instead of the shaft 72 and the handle support 73. The cylindrical shaft 431c can replace the shaft 72 as well as the handle support portion 73 by forming it to have the same length and the same diameter as the shaft 72. The cylindrical shaft 431c will not only result in a cheaper and stronger shaft and handle support section, but it will also reduce the number of parts required (i.e. since the handle support, namely, protrusions 431p are an integral part of the shaft 431).

Figs 11H shows a perspective view of a sheet of steel which has been pressed and rolled to form a handle. Referring to the Fig., a large sheet of metal (not shown) is first punched and pressed to cut it into smaller sheets of metal 432 having a desired length and width, as well as a pair of holes 732h using conventional cutting machines well known in the art. Next, the sheet of metal 432 with the two holes 432h is rolled to form a semi-cylindrical handle 432a having two holes 432h located at diagonally opposing sides thereof. This handle 432h can be used instead of the handle 71 in conjunction with the shaft 431c by mounting the protrusions 431p of the shaft 431c in the holes 432h of the handle 432a . This will results in a very

cheap and strong handle to replace the handle 71. Since the handle 432h is formed of sheet metal, it is flexible in nature and can be squeezed to fit inside the saddle support 23. Preferably a sheet metal which does not rust should be used, i.e. aluminum, stainless steel, etc.

Fig. 11I shows a front view of a sheet of metal 433 before rolling it into a handle. Figs. 11J show a perspective view of the sheet metal 433 which has been pressed and rolled to form a handle 433a according to another embodiment of the present invention.

Referring to the Figs., a large sheet of metal (not shown) is first punched to cut it into smaller sheets of metal 433 having a desired length and width, using conventional cutting machines well known in the art, the cutting operation including a hole punching operation to form the two holes 433h. Next, the sheet of metal 431 with the two holes 433h is pressed and rolled to form the semi cylindrical shaft 433a having two inner flaps 433f each of which have the holes 433h formed therethrough at diagonally opposing sides. To mount this handle 433a on the shaft 431c, the flaps 433f are manually spread so that the protrusions 431p fit therebetween and slide into the holes 433h. When the flaps 433f are released the protrusions 431p are permanently locked inside the holes 433h in the handle 433a. The handle 433a is also flexible in nature and may be squeezed to frictionally fit inside the saddle support 23.

Fig. 11M shows a front view of a sheet of metal 444 before rolling and pressing it into a handle 444a. The sheet of metal 444 has been punched (i.e. cut) out of a much larger sheet of metal (not shown) using a metal mold having the shape of the sheet metal shown in the Fig. 11M. During this step, also a pair of through holes 444h are punched out of the sheet of metal. Next, the sheet metal 444 shown in Fig. 11M is pressed, and rolled to form the handle 444a shown in Fig. 11N, which shows a perspective view of the sheet metal 444 after it has been pressed and rolled

to form another handle 444a according to another embodiment of the present invention. More specifically, the sheet of metal 444 is first bent at lines A and B by 90 degrees and 160 degrees, respectively, and then the portion of the sheet metal between lines A and B is rolled to form a semi-cylindrical shape. The portion below the line B forms a female locking tooth like latch 444l (similar to the tooth like protrusion 71l of Fig. 10A). The portion above the line A comprises a pair of protrusions each having a V portion 444v and 444s, which together, after the handle 444a is formed into a semi-cylindrical handle 444a, produce a V shaped guide 444v and a round hole 444s for frictionally supporting the tube 6 and connector 77b therein (similarly to the V shaped guide 71v and hole 71s of Fig. 10A). Fig. 11P shows a side cross sectional view at line I-I in Fig. 11N of the handle 444a. Accordingly, the handle 444a can be made very cheaply and is very strong. To mount this handle 444a on the shaft 431c, the cylindrical body of the handle 444a is manually spread, so that the protrusions 431p fit therebetween and slide into the holes 444h. When the cylindrical body of the handle 444a is released, the protrusions 431p are permanently locked inside the holes 444h in the handle 444a. The handle 444a is also flexible in nature and may be squeezed to frictionally fit inside the saddle support 23.

Fig. 11R shows a perspective view of a sheet of metal after it has been punched and pressed to form another handle 4444 according to another embodiment of the present invention. Referring to the Fig., the numeral 4444a designates a sheet of metal which has been pressed into a U-shape having a pair of holes 4444h formed at opposite sides thereof for mounting the handle on to the round protrusions 431p of the shaft 431c. Numeral 4444t designates a series of different size octagonal holes punched through the handle 44444, which can be used as tools (i.e. wrenches) to tighten or loosen screws on the bicyle.

Figs. 13A-13F show a perspective view, a side view, a top view, a bottom

view, a front view and a back view of the air outlet portion according to the present invention. Fig. 13G shows a side cross sectional view at line I-I of Fig. 13C. Referring to the Figs., numeral 75 generally designates the air outlet portion, numeral 75a designates a round shaft portion which frictionally fits into the other end of the pipe 70, numeral 75r designates a round ridge portion one end of which is integrally formed with one end of the round shaft portion and the outer diameter of which is the same as the pipe 70, numeral 75c designates a round main body portion one end of which is integrally formed with the other end of the ridge portion 75r and the diameter of which is smallest around the central part thereof and the bottom 75b (i.e. the other end of the main body portion 75c) of which is formed in a concave shape along one plane thereof. Numeral 75t designates a tail portion one end of which is integrally formed along the bottom surface and back side of the main body portion 75 and numeral 75e designates a round portion formed at the other end of the tail portion 75t. The tail portion 75t is rectangular in shape and the extending portion 75e is round and provides the function of a foot rest for the user of the air pump to stand on while pumping air. The tail portion is flexible and can be twisted around the bottom of the main body portion due to the material used in the manufacture thereof and due to its thinness thereof. The air outlet portion is made of plastic or nylon. Numeral 7c designates a conventional female metal connector made of brass or aluminum or any other suitable material which is embedded (an insert) using conventional plastic injection molding techniques along the front middle section of the main body portion 75m. Numeral 75z designates an air passage hole which extends from the top surface of the round shaft 75a through main body portion 75m to the metal insert connector 7c, so that compressed air in the air pump 111 can flow therethrough. Numeral 75h designates a through hole formed along the front bottom section of the main body portion 75m in the axial direction thereof and numeral 75s designates a vertical slot formed along the front bottom

portion of the main body portion 75m, the slot 75s extending from the outside periphery of the main body portion 75m to the through hole 75h. The width of the slot 75s is less than the width of the tail portion 75t and the diameter of the through hole 75h is equal to or greater than the with of the tail portion 75t but less than the diameter of the round portion 75e, so that the tail portion can be locked therein as will be explained later. Further, the concave shaped bottom surface 75c can be used to position the pump over the rim of a wheel (not shown). Moreover, for providing further support and stability, the slot 75s and the hole 75s can be used either to further support, in conjunction with the concave surface 75b, the main body portion 75m on the rim of a wheel by placing a spoke of the wheel inside the hole 75h or by sliding the air valve of a tire (not shown) into the hole 75h while pumping air into the tire (not shown) and using the hose 7n and connectors 7a and 7b.

Figs. 13H-I show a side and front view of the air outlet portion 75 with the flexible tail portion 75t thereof twisted around the bottom of the air outlet portion 75 with the round portion 75e of the tail 75t locked in a hole 75h. To wrap the tail portion around the bottom of the air outlet portion 75, the extending round portion 75e is first manually bent downwards and around the portion 75 and then the tail portion 75t is twisted by 90 degrees so that the thin side of the tail portion 75t can slide into the slot 75s into the hole 75h, and then the tail portion is let go so that it automatically locks itself in the hole 75h. In this way, not only is the tail portion 75t in a storage position but it also provides the function of anti-sliding friction means when the air pump is inserted inside the saddle post frame support section 25. Namely, even in the storage position of the tail portion 75t, the tail portion 75t has a peripheral diameter greater than the inner diameter of the frame support section 25, and, accordingly, must be manually pushed into the frame support section 25, which causes the tail section to contort and fit inside the frame support section 25. Moreover, the tail section 75t not only provides for anti-sliding friction generating

means but also prevents the bottom of the air pump 111 from vibrating inside the frame support section 25 when the user is riding the bicycle.

It should be noted that another advantage of making the main body portion 75m thinner along the central part 75c thereof is that the connector 7a when screwed into the connector 7c is protected from being damaged while the user pumps air. When the user pumps air, a lot of force is exerted on the pump and if by chance the metal connector 7a is pushed against a part of the bicycle or against the ground, it may damage the threads on the connectors 7a and 7c. However, with the present structure, a small protective "pocket" is created for the connector 7a by the main body portion 75.

Accordingly, the main body portion 75 has no part thereof extending beyond the periphery of the cylindrical portion 70 and , since the connector 7c is mounted along the central portion of the main body portion 75, the bottom surface of the main body portion 75 can be used to push against the ground or the rim of a wheel when the air pump 111 is used to pump air.

Fig. 13J and 13K show a bottom view of the air outlet portion 750 and a perspective view of a tail portion 751 according to another embodiment of the present invention. The air outlet portion 75 and 751 are substantially the same and only the differences between them will be described herebelow. All identical parts will be designated by the same numerals. Referring to the Figs., it can be seen that the main body portion 75m has no tail section 75t and instead has a rectangular slot 750s formed at the back side of the main body section 750 in the axial direction thereof. The tail portion 751 comprises at one end thereof a V shaped latch 7511 . The rest of the tail portion 751 is identical to the above described tail portion 75t. To assemble the tail 751 in the air outlet portion 750, the latch portion 7511 is manually pushed through the slot 750s to interlock therewith. Accordingly, the tail portion 751 and the air outlet portion 750 can be manufactured separately, and accordingly,

can comprise different colors, as well as using different decorative designs for the round portion 75e. Namely, the round portion 75e can be formed to have the shape of the Canadian Maple Leaf, the American Flag, Mickey mouse, Snoopy, etc.

It should be noted that instead of the vertical slot 750s, a horizontal slot (not shown) can be formed extending from the front of the air outlet portion 75, just below the connector 7c, to the back side of the air outlet portion 75 and the tail section 75t can be mounted therein.

Presently, foot-hand air pumps have a foot rest which are quite large, heavy and relatively complex in structure. Also, they are always a separate part and accordingly require additional manufacturing cost as well as assembly. The foot rest comprising the portions 75t and 75e are extremely light and cheap, and require no assembly steps, since they are an integral part of the air outlet portion 75.

It should be noted that the tail portion 75t may also be used to mount the air pump 111 to the outside frame of the bike by wrapping it around a frame portion of the bike and locking the round portion 75e in the hole 75h.

It should be noted that the round shaft portion 75a may have a thread formed on the outer surface thereof for screwing the air outlet portion 75 into a similarly formed thread formed along the inner lower end of the cylindrical body 70.

Fig. 13L shows a side cross sectional view of the air outlet portion 750 according to another embodiment of the present invention, which further includes a one way air valve incorporated therewith. Fig. 13M shows a perspective view of a female connector 700 used with the air outlet portion of Fig. 13L. Fig. 13N shows an enlarged perspective view of a disc 751 used as a one way air valve in Fig. 13L. Fig. 13O shows a side view of a disc 751 shown in Fig. 13N. Fig. 13P shows a side cross sectional view of the air outlet portion of Fig. 13L without the female connector 700 and disk 751assembled therein. In the Figs, the same numerals will be used to designate the same or similar portions as those of the air outlet portion 75

described above and only the parts which are different will be described herebelow.

Referring to the Figs. 13L-P, numerals 753, 754 designates an outer and inner round cavities formed in the main body portion 75m which respectively extend from the front side of the main body portion 75m into a center thereof. The cavities 753, 754 are adjacent to each other and are coaxial with each other. The diameter of the outer cavity 753 is larger than the diameter of the inner cavity 754. The inner cavity 754 connects with the inner end of the air passage hole 75z. The diameter of the inner cavity 754 is larger than the diameter of the air passage hole 75z. The walls of the outer cavity 753 have a female thread 753t formed thereon and the walls of the inner cavity 754 are smooth. Numeral 751 designates a round disc which is made of rubber or nylon, the outer diameter of which is slightly less than the diameter of the inner cavity 754 and the thickness of which is slightly less than the length of the inner cavity 754, whereby, the disc 751 can move freely back and forth in the inner cavity 754 in the axial direction thereof. The back surface of the disc is smooth while the front surface thereof has a plurality of round protrusions 751p formed thereon. Numeral 758 designates an O ring the outer diameter of which is the same as the diameter of said outer cavity 753 and serves the purpose of being an air seal. Numeral 700 designates a cylindrical female connector portion having threads 700a, 700b formed on the inner and outer surfaces thereof, respectively. The outer threat 700a of the connector portion 700 fits the inner thread 753t of the outer cavity 753, so that the connector portion 700 can be screwed into the outer cavity 753. The length of the connector portion 700 and the outer cavity 753 are substantially the same. Numeral 700g designates a pair of grooves formed along one end of the connector portion 700. The grooves 700g each extend from the periphery of the connector 700 partially inward in the radial direction of the connector portion 700. The grooves 700g are used for screwing the connector portion 700 into the main body portion 75m using a specially designed screw driver. The inner thread 700a of

the connector portion 700 fits the thread on the male connector 7a. The connector portion 700 is made of metal, such as aluminum or brass.

The outer and inner cavities 753, 754 in the main body 75m, the disc 751 and the female connector portion 700 provide the function of a one way air valve, which is very easy to construct, and requires only one additional part, namely the disc 751, since the connector portion 700 is required for connecting the male connector portion 7a. The operation of the one way valve will be described herebelow.

When pumping air using the air pump 111, air moves through the air passage hole 75z from the top of the air outlet portion 750 (as seen in the Fig. 13L) to the inner cavity 754 causing the disc to move to the left (as seen in the Fig. 13L) to come against the inner surface of the connector 700, whereby air passes around the disc 751, through the connector 700 and into the tire being inflated (not shown). When air is not being pumped by the air pump 111, the air in the tire tries to flow back through the connector 700 causing the disc 751 to move to the right (as seen in Fig. 13L) to press against the inner wall of the inner cavity 754, to stop air flow from the tire back into the pump 111. The protrusions 751p allow air to flow therebetween during the air pumping operation.

Figs. 15A and 15B show a side view and a side cross sectional view of conventional male and female connectors 7a and 7b having respective ends thereof mounted in a nylon tube 7n according to an embodiment of the present invention. Referring to the Fig., the male connector 7a comprises a male tread portion 711 for screwing into the female connector 7c, a round portion 712 for allowing a person to grip and turn the connector 7a, a round sleeve portion 713 having a pair of cone shaped protrusions 714 formed along the outer surface thereof for better gripping the end of the nylon tube 7n mounted thereon. Numeral 715 designates a through hole formed through the male connector 7a in the axial direction thereof. The female connector 7b comprises a round portion 716 for allowing a person to grip and turn

the connector 7b, a female thread portion 717 formed along the inner surface of the portion 717 for screwing unto a bicycle air valve (not shown), a round sleeve portion 718 having a pair of coned shaped protrusions 719 formed along the outer surface thereof for better gripping the respective end of the nylon tube 7n mounted thereon. Numeral 800 designates a through hole formed through the central portion of the connector 7b in the axial direction thereof. Accordingly, turning the female connector 7b requires the nylon tube 7n as well as the entire air pump 1, 11 or 111 to be turned therewith which is very cumbersome.

Fig. 15C designates a side cross sectional view of a female connector 77b according to an embodiment of the present invention. Fig. 15D-15F show a side cross sectional view, a side view and a side view of the first, second and third portions 801, 802, 803 of the connector 77b before the assembly of the connector according to the present invention. Figs. 15G and 15H show a front and back view of a first part 801 of the connector 77b. Fig. 15I shows a front view of the second portion of the connector 77b. Figs. 15J and 15K show a front and back view of the third portion of the connector 77b.

Referring to the Figs. 15C-15K, the first portion 801is cylindrical in shape. The inner walls of the cylindrical first portion 801 comprise a threaded section 801t and a smooth inner wall section 801s, the threaded section 801t extending from one end of the cylindrical first portion 801 and the smooth inner wall section extending from the other end to the point where the treaded section ends, the inner diameter of the threaded portion 801t being less than the diameter of the smooth wall section 801s. The second portion 802 comprises a donut shaped flat ring 802r having a hole 802h formed through the center thereof, the ring 802r having an outer diameter which is substantially the same as the inner diameter of the smooth wall section 801s and the central through hole 802h having a diameter which is less than or equal to the diameter of the central hole in a bicycle tire valve (Dunlop type valve or British

type valve), not shown. The second part 802 is formed of rubber, nylon or pvc material and acts as an air seal to prevent air from escaping outwards during the pumping of air by the air pump. The third part 803 comprises a donut shaped flat ring section 803r having a hole 803h formed through the center thereof, the ring 803r having an outer diameter which is slightly less than the inner diameter of the smooth wall section 801s and bigger than the inner diameter of the threaded section 801r of the first portion 801and the central through hole 803h having a diameter which is the same as the diameter of the hole 802h in the second portion 802. The third part 803 further comprises a cylindrically shaped sleeve section 803s having two cone shaped protrusions 803p formed along the outer surface thereof. One end of the sleeve section 803s is integrally formed along one side of the flat ring section 803r along the central portion thereof. The sleeve section 803s has a through hole 803h formed through the central thereof, the holes 802h and 803h having the same diameter and being co-centric. The first and third part 801 and 803 are formed of metal, such as brass, aluminum or steel.

To assemble the connector 77b, the second part 802 and the donut shaped ring section 803r of the third part 803 are inserted inside the smooth wall section 801s area of the first part 801 and then the second end of the first part 801 are pressed (i.e. pinched) inwards, using conventionally known cold metal pressing machines, to form a wall 801w which prevents the second part 802 and the donut shaped ring section 803r from coming out of the first part 801, while allowing the first part 801 to be rotated manually with respect to the third part 803. Accordingly, when the first part 801 is screwed manually unto a bicycle air valve (i.e. Dunlop type valve), not shown, the extending end of the air valve, not shown, pushes against one side of the second portion 802 to create an air tight seal, while allowing for air to flow into the tire via the central through holes 802h and 803h.

Referring to Figs., 15A-15C, numeral 7d designates pair of cylinder shaped

sleeves (hereinafter referred to as pressure applying sleeves) formed of metal or plastic which are used to prevent air from escaping between the ends of the nylon hose 7n and the connectors 7a and 7b or 77b according to the present invention. Numeral 7e designates a coil type spring (hereinafter referred to as pressure applying spring) formed of spring metal, commonly found on key chain holders, which can be used instead of the pressure applying sleeves 7d. The inner diameter of the pressure applying sleeve 7d and spring 7e are the same as the outer diameter of the nylon tube 7n, so that the tube 7n can be easily inserted inside the pressure applying sleeve 7d or pressure applying spring 7e. The outer diameter of the sleeve portions 713, 718 and 803s of the connectors 7a, 7b and 77b are the same as the inner diameter of the tube 7n and the outer diameter of the protrusions 714, 719 and 803p are slightly bigger than the inner diameter of the nylon tube 7n and slightly less than the inner diameter of the pressure applying sleeve 7d or pressure applying spring 7e.

To assemble the connectors 7a, 7b and the sleeves 7d on the tube 7n, first two sleeves 7d are slid onto the tube 7n, so that they are at least 3 cm. away from the respective ends of the tube 7n, then the sleeve portions 713 and 718 are manually forced to slide into the respective ends of the tube 7n, and then the pressure applying sleeves 7n are manually pulled towards the respective ends of the tube 7n. This is all possible due to the resilient flexible nature of the nylon (or rubber) material of the tube 7n, which allows the tube 7n not only to stretch but also be compressed, whereby, not only do the pressure applying sleeves 7d prevent any air from escaping between the ends of the tube 7n and the connectors 7a and 7b, but also prevent sleeve portions 713 and 718 from coming out of the ends of the tube 7n. The same method is used to mount the connector 77b on the tube 7n. Also the same method is used to mount the pressure applying spring 7e on the tube 7n. The pressure applying spring 7e can also change its inner diameter due to the inherent springy nature thereof, thereby making it easier to assemble the spring 7e while providing a

constant spring pressure on the tube 7n and the connectors mounted therein at all times. These pressure applying sleeves 7d and pressure applying springs 7e provide a cheap, light and easy to assemble solution to prevent air from escaping between the ends of the vinyl tube 7n and the connectors 7a, 7b or 77b.

Figs. 16A-16C show a side view, front view, back view of a piston 76 having a rubber O-ring 79 mounted thereon. Fig. 16D shows a side cross sectional view of the piston 76 at line I-I of Fig. 16B. Referring to the Figs., numeral 76s designates a round central shaft, numerals 76a designates a first round ring integrally formed with the shaft 76s at one end thereof, numeral 76b designates a second round rings integrally formed with the shaft 76s along a central portion thereof. The front and back walls 1f, 2f, of the first ring 76a are perpendicular to the shaft 76s. The front wall 3f of the second ring 76b is slanted at an angle of 80 degrees with respect to the shaft 76s while the back wall 4f is perpendicular to the shaft 76s. Numeral 76g designates a pair of rectangular shaped grooves formed at opposite sides of the first ring 76a. The grooves 76g extend through the first ring 76g in the axial direction of the shaft 76s. The outer diameters of the first and second rings 76a, 76b are the same. Numeral 79 designates an O-ring which is made of rubber, having an inner diameter which is greater than the outer diameter of the shaft 76 but less than the outer diameter of the first and second ring 76a 76b, and an outer diameter which is greater than the outer diameter of the rings 76a and 76b. The space between the first and second rings 76a and 76b in the axial direction of the shaft 76s is greater than the thickness of the O-ring 79. The other end of the shaft 76s is frictionally fitted inside the cylindrical hollow shaft 72.

In operation, when pumping air into the bicycle tire, the piston 76 is pushed by the shaft 72 inside the cylinder 70 to cause the inclined wall 3f to push the O-ring 79 forward to push air inside the cylinder 70 through of the connector 7c. When the piston 76 is pulled by the shaft 72, the O-ring moves against the second wall 2f of

the first ring 76a allowing for air to pass over the second ring 76b, between the O-ring inner surface and the shaft 76, and through the rectangular grooves 76g to get ready for the next pumping stroke.

It is well know in the art that keeping the inner walls of the cylinder 71 and the O ring 79 lubricated provides for better air pumping characteristics. However, the lubrication tends to dry out over time. Accordingly, it would be desirable to have a reservoir of lubricant and a method which self adjusts the lubricating rate of the O-ring 79 and the inner walls of the cylinder 71. The following embodiment discloses such an apparatus.

Figs. 17 A-C show a side view, a front view and a back view of a piston 83 having a lubrication reservoir tank 83r according to the present invention. Fig. 17D shows a side cross sectional view of the piston 83 at line I-I of Fig. 17B. The piston 83 is substantially the same as the piston 76 and similar parts will be designated by the same reference numerals. Only the differences between the piston 83 and 76 will be described herebelow. Referring to Figs. 17A-D, numeral 83r designates a round central hole formed in the center of the shaft 83s, the hole 83r extending in the axial direction of the shaft 83s from one end of the shaft 83s (i.e. where the first ring is formed) to a point inside the shaft 83s which is in a radial position substantially the same as the point where the second ring is formed on the shaft 83s. Numeral 83l designates two diagonally opposed holes which extent through the shaft 83s from the outer surface thereof to the central hole 83r. The physical dimensions of the shaft 83s and 76s, the rings 76a and 76b of the pistons 76 and 83 are identical. The central hole 83r acts as a lubrication reservoir for storing grease (i.e. not shown) or any other high viscosity lubricating material therein, whereas the lubrication holes 83l allow for the grease to flow out of the reservoir 83r to the space between the first and second ring 76a, 76b to lubricate the O ring 79. Namely, each time the piston 83 is pushed forward towards the connector 7c during the air pumping stroke, a high

pressure is created inside the air pump which pushes on the grease in the reservoir 83r causing a very small amount of the grease to flow out of the lubricating holes 831 to lubricate the O ring 79.The diameter of the lubrication holes 831 can be set to give the best lubrication effect, namely, to provide just the right amount of lubrication flow each time the user pumps air.

Figs. 18 A-C show a side view, a front view and a back view of a piston 84 according to another embodiment of the present invention. Fig. 18D shows a side cross sectional view of the piston 83 at line I-I of Fig. 18B mounted inside the cylinder 70 mounted on the shaft 72. Referring to the Figs., numeral 84s designates a round shaft having three radially extending rings 84a, 84b and 84c integrally formed therewith along the outer surface thereof, the rings 84a, 84b and 84c being spaced apart in the axial direction of the shaft 84s by a distance which is slightly greater than the thickness of respectively mounted first and second O rings 841 and 842. The first O ring 841 is mounted between the first ring 84a and second ring 84b, and the second O ring is mounted between the second ring 84b and third ring 84c The first and second rings 84a, 84b each have a pair of diagonally opposed semi-round grooves 843, 844 formed on respective inner surfaces f6, f8 thereof, each groove 843, 844 extending from the outer surface of the shaft 84s in the radial direction thereof to the outer surface of the respective rings 84a, 84b. The two pairs of grooves 843, 844 each only partially extend through the rings 84a, 84b in the axial directions thereof. Furthermore, the two pairs of grooves 843, 844 are in line with each other in the radial direction of the rings 84a, 84b to facilitate for an easy injection mold during the manufacture thereof. The purpose of having two O rings instead of one O ring is that having two O rings will enhance the air pumping characteristics of the piston 84. the operation of the piston 84 will be described herebelow.

Referring to Figs. 18A and 18B, during the air pumping stroke, the tow O

rings 841 and 842 are pressed against the inner facing surfaces f7 and f9 of the second and third rings 84b and 84c to push air out of the pump through the connector 7c. When the piston 84 is pulled away from the connector 7c by the shaft 72, the O rings 841 and 842 are pressed against the outward facing surfaces f6 and f8, whereby air passes between the cylinder 70 and the top of the rings 84a, 84b and 84c, between the inner surfaces of the O rings 841 and 842 and the outer surface of the shaft 84s via the grooves 843 and 844, respectively. Accordingly, with this structure, at substantially the same cost, since O rings are very cheap, a much improved air pumping piston 84 is realized.

Fig. 18E shows a front view of a piston 840, further including an oil lubrication apparatus according to another embodiment of the present invention. Fig. 18F shows a side cross sectional view of the piston 840 at line I-I of Fig. 18E. In the Figs., the same reference numerals will be used to designate the same or similar parts to those of Figs., 18A-18D. Only the differences between these two embodiments will be described herebelow. Referring to the Fig, numeral 840s designates a shaft similar to the shaft 84s further including a central hole 840r formed in the axial direction thereof extending from the one front end thereof (i.e. where the first ring 84a is formed) to a central portion thereof. The hole 840r can be used as a lubrication reservoir by filling it with grease or a silicon based lubricant having a viscosity which provides the desired lubricating characteristics. Numeral 840l designate a pair of through holes which extend in the radial direction of the shaft 840s from the central through hole 840r to the outer surface of the inner periphery of the third ring 84c. Accordingly, when pumping air using the piston 840s, an air pressure difference is created between the air pressure on the surface f5 and the air pressure on the periphery of the third ring 84c, whereby lubricating material stored in the reservoir 840r is pushed through the holes 840l to lubricate the second O ring 842 and, accordingly, the inner surface of the air pump cylinder 80,

thereby providing even better air pumping characteristics.

Fig. 19A shows a side cross sectional view of a foot-hand air pump 1111 similar to the air pump 111 of Figs. 14A-14C, further including a pressure indicating gauge according to the present invention. Fig. 19B shows perspective view of a handle 710 of the air pump 1111. Fig. 19C shows perspective view of a handle support 730 of the air pump 1111. In the Figs., the same or similar parts will be designated by the same numerals as the parts shown in Fig. 14A and only the differences between the pumps 111 and 1111 will be described herebelow. Referring to the Figs., numeral 760 designates a piston which is substantially the same as the piston 76 but further including a cylindrical portion 760c integrally formed with the extending end of the shaft portion 76s. The outer diameter of the shaft portion 76s and the cylindrical portion 760c are the same and are formed to be slightly smaller than inner diameter of the shaft 72, so that they can slide inside the shaft 72. Numeral 900 designates a spring the inner diameter of which is slightly larger than the outer diameter of the shaft portion 76b and the cylindrical portion 760c and the outer diameter of which is the same as the outer diameter of the shaft 72. One end of the spring 900 is on the top surface of the ring 76b of the piston 760 and the other end of the spring 900 buts up against the extending end of the shaft 72. Numeral 760l designates a flexible rectangular strip one end of which is integrally formed with the extending end of the cylindrical portion 760c and the other end of which has a round portion 760e integrally formed therewith. The piston 760 is formed of any suitable flexible material such as plastic or nylon.

Referring to Fig. 19B, the handle 710 is similar to the handle 71 and only the differences therebetween will be described herebelow. The same reference numerals will be used to designate the same or similar parts. Numeral 710w designates a wall similar to the wall 71w, but further including an opening 710h formed at the back side of the wall 710w and numeral 710s designates a narrow slit joining the opening

710h with the back of the through hole 71s. Numeral 710v designates a through viewing hole formed in the semi-cylindrical body71b in the vicinity of the opening 710h formed in the wall 710w.

Referring to Fig. 19C, the handle support 730 is similar to the handle support 73 and only the differences therebetween will be described herebelow. The same reference numerals will be used to designate the same or similar parts. Numeral 730r designates a ridge similar to ridge 73w, but having a groove 730s formed therein. The handle support 730 is the same as the handle support 73 in all other aspects.

The nylon strip 760l extends from the end of the cylinder 760c through the inside of the shaft 72, through the groove 730s formed in the handle support 730, along the inside of the handle 710 and through the opening 710h in the wall 710w. The end portion 760e of the nylon strip 760l has a diameter which is greater than the width of the opening 710h, so that it can not be pulled therethrough. The length of the nylon strip 760l is just long enough so that the end portion 760e extends out of the opening 710s when the spring 900 is in its fully extended (i.e. no air pressure) state. The operation of the air pressure measuring device described hereabove will be described herebelow.

When a person presses down on the handle 710 to pump air into a bicycle tire, depending on the air pressure in the tire (i.e. how full the tire is), will determine the force the user has to exert on the handle 710 to push the air out of the pump 1111 and accordingly, the degree to which the spring 900 is deformed (i.e. compressed), whereby, the cylinder 760c moves a corresponding distance further up into the shaft 72, causing the nylon strip 760l to move up as well, which causes the extending end 760e to move out of the end of the handle 710, thereby providing the user with a visual indication as to how much air pressure is in the tire. Markings can be made on the upper surface of the nylon strip 760l near the end 760e to indicate the degree

of air pressure. Alternatively, the upper surface of the nylon strip 760l near the end 760e can have horizontal yellow, green and red stripes painted on it, so that when the air pressure is low, the yellow stripes appears in the viewing hole 710v, when the pressure is medium, the green stripe appears in the viewing hole 710v and when the pressure is high, the red stripe appears in the viewing hole 710v, whereby an easy visual indication of air pressure is displayed while the user is pumping air. Furthermore, the user doesn't have to understand what psi stands for (i.e., pounds per square inch). The width and thickness of the nylon strip can be chosen so that the nylon strip is rigid enough to move the end portion 760e when the spring 900 is compressed while still flexible enough to be bent by the handle 710 when the handle 710 is turned from a vertical position to the horizontal position.

To assemble the above described foot-hand air pump 1111, first the air outlet portion 75 is frictionally inserted and glued to the other end of the cylinder 70 (i.e., the end with no thread formed therein). Next, the handle support 730 is frictionally mounted on one end of the shaft 72. Next, the swivel handle 710 is mounted on the handle support 730 as described above for the handle 73. Next, the other end of the shaft 72 is inserted through the center hole of the end cap 74, so that the end cap 74 sits somewhere along the outer surface of the shaft 72. Next, the strip 760l is fed through the center of the spring 900 until the spring 900 is around the cylinder 760c. Next, the strip 760l is fed through the central hole in the shaft 72 from the other end thereof, and then though the space between the inner side of the handle 710 and the top of the handle support 730, so that the strip 760l fits in the groove 730s. Next, the end portion 760e is pulled through the V shaped slot 71v and through the hole 71s of the wall 710w. Next, the end portion 760e is twisted by 90 degrees so that the narrow side of the strip 760l can slide through the slit 710s and into the opening 710h, whereby the end portion is locked in the opening 710h in the wall 710w due to the end portion 760e being larger in diameter than the opening 710h. Next, the end

cap 74 is screwed into the threaded portion of the cylinder 70. The length of the strip 760l is formed to be such that when the end portion 760e of the strip 760l is against the outer surface of the wall 710w, a very small pressure is exerted on the spring 900, namely, the ends of the spring 900 are against the upper surface of the second ring 76b and against the other end of the shaft 72, respectively. In this way the foot-hand air pump 1111 is prevented from coming apart during the air pumping action. In other words the end portion 760e also serves to lock all the parts of the air pump 1111 together. Accordingly, a very simple and cheap assembly process is realized. Further very few parts are required, allowing for a very simple and cheap foot-hand air pump.

Figs. 20A, B show perspective views of a cap 761 and extension means 762 for the air pump 1111 according to another embodiment of the present invention. Fig. 20C shows a side cross sectional view of the cap at line I-I of Fig. 20A with the extension means 762 mounted therein according to the present invention. With this embodiment, the cylinder portion 760c of the piston 760 does not have the strip portion 760l integrally formed therewith at the extending end thereof. Referring to the Figs. Numeral 761 designates a cap comprising a cylindrical body 761b having a ridge 761r formed at one end thereof, the ridge having a central through hole 761h formed through the center thereof. Numeral 762 designates an extension means which comprises a two dimensional flat, thin and long strip of nylon 762n having an arrow shaped head 762a formed at one end thereof, a round portion 762r formed at the other end thereof and a T-shaped protrusion 762t. The width of the arrow 762a is greater than the diameter of the hole 761h formed in the ridge 761r but less than the inner diameter of the cylindrical portion 761b of the cap 761. The distance between the extending ends of the arrow head 76a and the T-shaped protrusion 762t is slightly greater than the thickness of the walls of the ridge 761r. To assemble the extension means 762 in the cap 761, the arrow portion 762a is pushed through the

hole 761h so that the extending ends of the arrow 762a snaps into the cap 761, due to the elastic nature of the nylon material of the extension means 761, thereby locking the extension means 762 inside the cap 761. The extension means 761is free to rotate inside the cap 761, so that the strip 762n does not get all tangled up or twisted when the user of the air pump 1111 turns the handle 710 clock wise or counter wise with respect to the cylinder 70 during the pumping operation. Since the nylon strip 762n is thin, the connector 7a and nylon tube 7n can still slidingly fit inside the shaft 72 adjacent to the strip 762n.

It should be noted that the cylinder 70 and the shaft 72 can be made of transparent plastic, in which case, the cylinder 760c would become visible from outside the air pump 1111, and, accordingly, by printing numbers on the outer surface of the shaft 72 at appropriate positions in the axial direction thereof indicative of pressure, the position at which the extending end of the cylinder 760c is with respect to the printed numbers on the shaft 72 can be used to indicate the pressure of the air being pumped by the air pump 1111. This embodiment would simplify and reduce the cost of the air pump 1111, since the strip 760l would not be required.

Fig. 20D shows a side cross sectional view of a foot-hand air pump 11111 similar to the air pump 1111 of Figs. 19A including a pressure indicating gauge according to another embodiment of the present invention. The foot-hand air pump 11111 is very similar to the foot air pump 1111 and only the differences therebetween will be described herebelow. The same numerals will be used to designate the same or similar parts. Referring to Fig. 20D, it can be seen that the strip 760l has been removed. Further, the outer diameter of the cylindrical portion 760c of Fig. 20C is slightly smaller than the outer diameter of the cylindrical portion of 760c of Fig. 19A, so that some space is available between the inner walls of the shaft 72 and the outer walls of the cylindrical portion 760c. Numeral 37 designates a

first part comprising a round shaft portion 37s having a round disc portion 37d integrally formed therewith at one end thereof, the round shaft portion 37s having an outer diameter which is equal to the inner diameter of the cylindrical portion 760c so that it may be frictionally mounted therein, and the disc portion 37d having an outer diameter which slightly smaller than the inner diameter of the shaft portion 72 so that it may freely slide therein. The outer diameter of the disc portion 37d is larger than the outer diameter of the cylindrical portion 760c. Numeral 38 designates a second part comprising a cylindrical portion 38c having a ridge portion 38r integrally formed therewith along the outer surface thereof at one end of the cylindrical portion 38c. The outer diameter of the cylindrical portion 38c is the same as the inner diameter of the shaft 72 so that it may be frictionally mounted therein and the inner diameter of the cylindrical portion 38c is slightly bigger than the outer diameter of the cylindrical portion 760c so that the cylindrical portion 760c may freely slide therein. The outer diameter of the disc portion 37d is larger than the inner diameter of the cylindrical portion 83c, so that the cylindrical portion 760c is permanently locked in the shaft 72.

To assemble the air pressure apparatus of this embodiment, the spring 900 is first mounted on the cylindrical portion 760c. Then, the extending end of the cylindrical portion 760c is inserted into the central hole in the cylindrical portion 38c of the second part 38 with the ridge portion 38r facing the spring 900. The second part 38 freely slides on the cylindrical portion 760c because the central hole in the cylindrical portion 38c is slightly bigger than the outer diameter of the cylindrical portion 760c. Next, an adhesive material (not shown) is applied to the outer surface of the shaft portion 37s of the first part 37 and then the shaft portion 37d is pushed into the hole in the extending end of the cylindrical portion 760c, so that it is permanently fixed therein. Next, the first part 37, (which is now permanently fixed inside the extending end of the cylindrical portion 760c) and the extending portion of

the cylindrical portion 760c are partly inserted inside the shaft 72. The disc portion 37d freely slides inside the shaft portion 72 because the outer diameter of the disc portion 37d is slightly smaller than the inner diameter of the shaft 72. Next, an adhesive material (not shown) is applied to the outer surface of the cylindrical portion 38c of the second part 38 and then the cylindrical portion 38c is pushed into the extending end of the end of the shaft 72, so that the cylindrical portion 38c is permanently fixed in the end of the shaft 72. The remaining portions of the air pump 11111 are assembled in the same way as explained above with respect to the air pump 1111. When no force is exerted on the handle 710, the first and second parts 37, 38 abut each other inside the shaft 72 and the ends of the spring 900 should be touching the ridge 38r and the upper surface of the piston 760, respectively. Accordingly, the first and second parts 37, 38 not only allow the piston 76 to move with respect to the shaft 72, but also prevent the cylindrical portion 760c from coming out of the shaft 72. When the pump 11111 is used to pump air into a tire of a bicycle wheel, a force is exerted on the handle 710, causing the spring 900 to compress to a degree representative of the pressure of the air being pumped, and accordingly, the degree to which the cylindrical portion 760c and the first part 37 move into the shaft 72. Accordingly, by using a clear plastic material such as acryl, or poly propylin, etc., for the cylindrical portion 70 and the shaft 72, the disc portion 37d of the first part 37 becomes visible from outside the air pump 11111. Accordingly, by painting marking on the outside of the transparent shaft portion 72 at appropriate locations in the axial direction thereof representative of air pressure, the position to which the disc portion 37d moves to inside the shaft 72 designates the air pressure being pumped and, accordingly, the air pressure inside the air tire. This realizes a very cheap and simple air pressure measuring apparatus requiring very few parts and is very easy to assemble.

Fig. 21A-C show a side view, a top view and a bottom view of first part of an

air pressure indicating device according to another embodiment of the present invention. Fig. 21D shows a side cross sectional view of the first part 210 at line I-I of Fig. 21B. Fig. 21E shows a side cross sectional view at line I-I of Fig. 21B further including the rest of the air pressure indicating device according to the present invention. Fig. 21F-G show a front and back views of an end cap 211of the device 210. Fig. 21H shows a side view of an air pressure piston 212 of the air pressure indicating device. This air pressure device is very thin and round, cheap and easy to manufacture and can be connected between the connectors 7a and 77b by cutting the nylon tube 6 in half and inserting the two ends of the pressure indicating device into the respective ends of the cut tube 6.

Referring to Figs., 21A-21H, numeral 210 designates a first part comprising a round shaft having two round holes 210a, 210b formed therein. The first hole 210a passes right through the first cylindrical part in the axial direction thereof and provides the function of an air passage hole for passing pressurized air from the air pump to the tire being inflated. The second hole 210b extends from one end of the shaft 210 to a point near the other end of the shaft 210. Numeral 210c designates two round opening formed at the respective end of the shaft 210 for receiving end caps 211 therein. The diameter of the openings 210c is greater than the diameters of the holes 210a and 210b combined. Numeral 210h designates a round hole formed through the side wall of the shaft 210 which extends from the outside of the shaft 210 to the second hole 210b, the hole 210h being formed near the point where the second hole 210b ends inside the shaft 210. The shaft 210 is made from transparent plastic such as acryl using conventional injection molding techniques.

The end caps 211 are round in shape having a central through hole 211h formed through the center thereof. Numeral 211a designates the outer end of the cap 211, numeral 211p designates a pair of cone shaped protrusions formed at fixed intervals along the outer surface of the outer end 211a of the end cap 211 in the axial

direction thereof. Numeral 211r designates a round ridge formed on the outer surface of the outer end 211a of the end cap 211, the ridge 211r having an outer diameter equal to the outer diameter of the first shaft 210. Numeral 211b designates a round portion formed at the other end of the end cap 211, the outer diameter of the round portion 211b having the same diameter as the inner diameter of the openings 210c formed in the ends of the shaft 210, so that the round portions 211b frictionally fit inside the openings 210c and may be glued therein. The end caps are formed of plastic such as acryl, etc using conventional injection molding techniques.

Numeral 212 designates an air pressure piston having a donut shaped rubber O ring 213 mounted thereon. The piston 212 is round in shape and comprises a round shaft having two smaller diameter portions 212a, 212b and two larger diameter portions 212c, 212d in the axial direction thereof. The larger diameter portions are smaller than the inner diameter of the hole 210b formed in the first part 210, so that the air pressure piston 212 can freely slide inside the hole 210 b of the shaft 210. The O ring 213 is mounted on the smaller diameter portion 212b between the two larger diameter portions 212c, 212d. Numeral 214 designates a spring having an inner diameter which is greater than the outer diameter of the smaller diameter portion 212a and an outer diameter which is less than the inner diameter of the hole 210b, so that it may easily slide therein. One end of the spring 214 slides over the smaller diameter portion 212a and presses against one end of the larger diameter portion 212c. The other end of the spring 214 presses against the inner end of the hole 210b. The outer diameter of the O ring is the same as or slightly greater than the inner diameter of the hole 210b and the inner diameter of the O ring is greater than the outer diameter of the smaller diameter portion 212b of the piston 212 and less than the outer diameter of the larger diameter portions 212c and 212d of the piston 212. Furthermore, the O ring 213 should be a bright color such as red or green, etc., so that it is easily visible from outside the first part 210. The piston 212

is formed of plastic using conventional injection molding techniques.

The nylon tube 6 between the connectors 7a and 7b can be cut and the protruding ends of the end caps 211can be frictionally inserted therein, to provide a visual indication of the pressure being pumped by the air pump as will be described herebelow.

To assemble the air pressure device, first the spring 214 is inserted into the hole 210b. Next, the piston 212 with the O ring 213 mounted thereon is inserted into the hole 210c, so that the smaller diameter portion 212a slides into one end of the spring 214. Next, the end caps 211 are pressed into the respective opening 211b and glued therein. Next, the nylon tube 6 is mounted on the extending portions 211a of the end caps 211.

When pumping air using the air pump 111, air flows through the vinyl air pipe 6 and, accordingly, through the pressure indicating device in the direction shown by the arrows A. Namely, compressed air flows from one end of the hole 210a to the other end thereof. Some of the air B tries to flow up the second hole 210b, due to the air pressure differential between the compressed air inside the hole 210a and the atmospheric air pressure present in the top portion of the hole 210b due to the hole 210h, whereby the air pressure differential on the upper and lower sides of the O ring 213 causes the piston 212 to compress the spring 214. Accordingly, the position to which the O-ring moves to represents the pressure of the air being pumped and accordingly, the pressure in the air tire. By choosing a proper spring constant (i.e. F=kS, where F represents force, S the distance to which the spring is compressed and k the spring constant) for the spring 214 the desired effect can be realized for indicating air pressures normally present in bicycle air tires. Markings indicative of air pressure can be printed on the outer surface of first part 210. Alternatively, a narrow strip of paper having pressure markings printed on it can be slid into the hole 210a prior to the insertion of the end caps 211. The outer diameter of the shaft 210

can be made smaller than the hole in the shaft 72, so that it may be stored therein.

Figs. 22A-B show a top view and a bottom view of an air pressure measuring/indicating device according to the present invention. Fig. 22C shows a side cross sectional view at line I-I of the air pressure measuring/indicating device of Fig. 2A. Figs. 22D-E show a front view and back view of an air valve opening means 311 of Fig. 22C. Fig. 22F-G show a front view and back view of an round rubber sleeve 312 of Fig. 22C. Referring to the Figs, numeral 310 designates a round transparent portion having a round hole formed through the center thereof. Numeral 310e designates an end wall formed at one end of the round portion 310. The wall 310e has a central hole 310h formed therethrough. Numeral 310t designates a male thread portion formed at the other end of the round portion 310. The outer diameter of the round portion 310 where the thread portion 310t is formed is greater than the outer diameter of the rest of the round portion. The inner diameter of the hole 310h is the same as the inner diameter of the hole 210b of the shaft 210, so that the air pressure piston 212 and the O ring 213, as well as the spring 214 can be supported therein. Accordingly, the description of the air pressure piston 212, the O ring 213 and spring 214 will not be repeated herebelow. The round portion 310 is formed of transparent plastic such as acryl using conventional injection molding techniques. Numeral 311 generally designates an air valve open means for activating the air release device located at the center of a Schrader type American valve. The air valve open means 311 comprises a round flat portion 311r having a pair of through holes 311h formed therethrough in the axial direction thereof as well as a round shaft portion 311s formed on one side of the round flat portion 311r in the axial direction of the round flat portion 311. The air valve open means is formed of plastic using conventional plastic injection molding techniques. Numeral 312 generally designates a round rubber sleeve having two varying inner diameter concentrically formed holes 312s, 312p formed in the center thereof for

frictionally receiving therein a Schrader valve or a Presta valve, respectively. The outer diameter of the rubber sleeve 312 is the same as the outer diameter of the round portion 311r which is the same as the outer diameter of the threaded portion 310t. Numeral 313 generally designates a round cap portion having a central hole 313h formed through the center thereof in the axial direction thereof. Numeral 313w designates a wall formed at one end of the cap portion 313. The wall 313w has a hole 313p formed through the center thereof for receiving a Schrader valve or a Presta valve therethrough. Numeral 313t designates a female thread portion formed at the other end of the cap portion along the inner surface thereof. Numeral 313c designates a clip formed at the bottom side of the cap portion 313 for allowing the user thereof to attach the pressure measuring/indicating device to the pocket of a shirt. The outer diameter of the shaft portion 311s is smaller than the inner diameter of the central hole of a Schrader type valve, so that it may fit therein, and long enough to just activate the air release mechanism in a Schrader valve when the Schrader valve is pressed into the central hole 313p in the cap 313. The operation of the pressure measuring/indicating device will be described herebelow.

Referring to Fig. 22C, the rubber sleeve 312 is mounted in the the pressure measuring/indicating device with the smaller hole 312p of the rubber sleeve facing outwards, the hole 312p having a diameter which is slightly smaller than the outer diameter of a Presta type valve, so that the Presta type valve frictionally fits therein. When the Presta type valve is pushed into the hole 312p, the extending end of the Presta valve is pressed against the extending end of the shaft portion 311s causing it to open and release the air inside the tire tube, whereby the pressure measuring/indicating device is exposed to the high air pressure inside the air tire. The high pressure air in the tire (not shown) passes through the holes 311h in the round portion 311r and into the round hole in the round portion 310 and presses against one side of the O ring 213. Since the other side of the piston 212 is exposed

to room air pressure by the air passing through the hole 310h, an air pressure differential is present on the two sides of the O ring 213, causing the piston 212 to push on the spring 214 to move the piston to a point inside the hole in the round portion 310 indicative of the air pressure inside the air tire, similar to the way the piston 212 works as described above with respect to the air pressure indicating device shown in Figs. 21A-H. In case of measuring the air pressure in an air tube having a Schrader type of valve, the end cap 312 is unscrewed and the sleeve 312 is turned around so that the larger diameter hole 312s faces outwards. Then the end cap 313 is screwed back on. Then, the Schrader type valve is pushed into the hole 312s of the sleeve 312 until the air release pin inside the Schrader valve is activated by the shaft 311s, whereby, the pressure measuring/indicating device is exposed to the high pressure air inside the air tire (not shown). The pressure measuring/indicating device then works in the same way as described above with respect to the Presta type air valve to indicate the air pressure. Accordingly, by printing markings or embossing markings on the cylindrical shaft 310 representative of air pressure, the pressure inside air tires having a Schrader type valve or Presta type valve can be measured and visually indicated. This pressure measuring/indicating device can be manufactured very cheaply, and assembled very easily and is very compact in the form of a pen.

It should be noted that the pressure measuring/indicating device may further include a round shaft having an outer diameter the same as the diameter of the hole 310h and a length equal to the length from the end of the smaller diameter shaft 212a to just outside the hole 310h, so that when a high air pressure is being measured, the piston 212 pushes the round shaft out through the hoel 310 and the length to which said round shaft is pushed out of the shaft 310 indicates the amount of pressure being measured. Since the round shaft frictionally slides in the hole 310h, the round shaft has to be manually pushed back for the next measurement.